

AN ECOTONAL STUDY OF CARRION BEETLES (COLEOPTERA: SILPHIDAE) IN THE GREAT SWAMP NATIONAL WILDLIFE REFUGE, NEW JERSEY¹

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ABSTRACT: Carrion beetles were collected in chicken breast baited traps situated at 15 meter intervals, along a 60 m base line intersecting a woodland and field in Great Swamp National Wildlife Refuge, NJ. There was no evidence, for any species, of a declining linear gradient in numbers of carrion beetles from their preferred to their secondary habitat. An abrupt edge effect was noted for one species, *Nicrophorus orbicollis*, which was taken in the woodland and at the woodland/field interface, but not in the field proper. On the other hand, *Necrophila americana*, *Oiceoptoma noveboracense*, and *Oiceoptema inaequale* were each approximately equally abundant on either side of the actual interface of their preferred and secondary habitat. Furthermore, this junction zone (ecotone) may end between 15 m and 30 m into the field for *Necrophila americana* since it was found to be significantly more abundant at 30 m into the field (its preferred habitat).

Two previous studies have shown that carrion beetles (Silphidae) manifest slight to strong preferences for particular habitats. Anderson (1982) observed species preferences, in Canada, for coniferous forests, deciduous forests, fields and marshes. Shubeck (1983) observed species preferences when trapping carrion beetles in woodland, field, and marsh habitats in NJ. These findings are especially interesting in view of an earlier study which showed there is much random flight when carrion beetles search for carrion (Shubeck, 1968). In the New Jersey study it had been found that eight species of carrion beetles had slight or strong preferences for woodland or field habitats. Only 5% of the individuals were taken in a marsh.

Neither of the above habitat studies discussed ecotonal aspects of boundaries between habitats. According to Odum (1971), "An ecotone is a transition between two or more diverse communities as, for example, between forest and grassland . . ." He further stated, "It is a junction zone or tension belt which may have considerable linear extent but is narrower than the adjoining community areas themselves."

In this current study an attempt was made to determine what influence, if any, the ecotone might have on carrion beetle populations in terms of numbers. Specific objectives included an attempt to determine if there might be (1) a declining linear gradient in numbers of car-

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tion beetles, along a base line, from the preferred habitat to the secondary habitat, and (2) an abrupt drop in numbers at the interface between the preferred habitat and the secondary habitat. In other words, does the change occur at the interface itself or at 15 or 30 m inside of either habitat.

The study was conducted in the Great Swamp National Wildlife Refuge, Basking Ridge, NJ. Collections were made during June, July and August 1984, and April and May 1985.

MATERIALS AND METHODS

Carrion beetles were trapped in five No. 10 food cans (3.78 l), each of which was concealed in a wooden box having 1.27 cm wire mesh at the top and a rain cover 5 cm over the opening. These have been described elsewhere (Shubeck, 1976). A base line of 60 meters length was established which intersected the boundary at which a deciduous woodland and an old field were adjacent to each other. These habitats have been described in a previous paper (Shubeck, 1983).

The five traps were situated along the base line so that one trap was 30 m into the woodland, a second was 15 m into the woods, a third was at the edge of the woods where the field began, a fourth 15 m into the field, and a fifth was 30 m into the field. One chicken breast was placed in each trap a week before the first collection, a second added when collections began, and each week thereafter the older in each trap was replaced with a fresh chicken breast.

Traps were examined each week, carrion beetles were removed, identified, and the data recorded. There was a total of 21 weekly collections — 12 during June, July, and August in 1984, and 9 during April and May in 1985. A previous study (Shubeck *et al.*, 1981), which ran from April through November, had shown that over 98% of silphids collected in Great Swamp were taken from early April through August.

RESULTS AND DISCUSSION

A total of 1,173 carrion beetles (Silphidae) was collected during this study (Table 1). In rank order of abundance they were: 1. *Necrophila americana* (525); 2. *Oiceoptoma noveboracense* (349); 3. *Oiceoptoma inaequale* (206); 4. *Nicrophorus orbicollis* (66); 5. *Nicrophorus tomentosus* (12); 6. *Nicrophorus pustulatus* (6); 7. *Necrodes surinamensis* (5); 8. *Nicrophorus marginatus* (4). In view of the small numbers for the last 4 species this analysis and discussion will be limited to the four most abundant species whose larger numbers may be treated statistically.

Table 1 shows total numbers, for 1984 and 1985, of species trapped

along the base line intersecting the woodland and field interface. The data, for each species, show how many beetles were trapped 30 m into the woodland habitat, 15 m into the woodland, at the edge of woodland/field, 15 m into the field, and 30 m into the field.

Table 1 shows that no species exhibits a linear gradient in numbers collected from their preferred to their secondary habitat. Even the 4 species found in low numbers seem to bear this out (Table 1).

Only for *Nicrophorus orbicollis* was an abrupt edge effect noted. This species was trapped in approximately equal numbers at the edge of the woodland, and at 15, as well as 30 m into the wooded area. No individual of this species was taken within the field proper. These data seem to indicate that for *N. orbicollis*, the interface of its woodland habitat with a field can be a very real "barrier," or edge, beyond which this species seldom ventures in search for food. Although in a previous habitat study (Shubeck, 1983) 10 of a total of 73 individuals (13.7%) were taken in the field, the great majority (86.3%) was collected in the forest—their preferred habitat.

On the other hand, the 3 most abundant species behaved very differently. *Necrophila americana*, *Oiceoptoma noveboracense*, and *Oiceoptoma inaequale* were captured in somewhat similar numbers along the base line (with the possible exception of *N. americana* since 30% of its numbers were taken 30 m into the field). It seems clear for these species there is a definite ecotone, or zone, which extends from within one habitat, across the edge into its adjacent habitat. Within this zone it appears these beetles were approximately equally abundant on either side of the actual interface of the preferred and the secondary habitat. In order to support this observation the chi square statistic was used to determine if the numbers of individuals from each of these 3 species, taken on either side of the interface (i.e. forest vs. field) were significantly different. The total number of individuals collected at 15 m and at 30 m into the forest was compared with the total number collected at 15 m and 30 m into the field for each of these species respectively. It was found there was no significant difference in the total number taken on either side of the actual interface (but within the 60 m wide margin tested) in the case of 2 species; *Oiceoptoma noveboracense* ($X^2 = 1.39$, $df = 1$, $P > .2$) Table 1, *Oiceoptoma inaequale* ($X^2 = 1.16$, $df = 1$, $P > .2$) Table 1. Chi square analysis of *Necrophila americana*, on the other hand, indicated there is a significant difference in the numbers on either side of the interface ($X^2 = 9.43$, $df = 1$, $P > .01$) Table 1. However, the data in Table 1 may indicate the junction zone, or tension belt (Odum, 1971), may end between 15 and 30 m into the field for this species, since it has been noted that *N. americana* manifested somewhat larger numbers 30 m into the

field. Chi square treatment of the numbers when all five collections for this species are included indicate a significant difference in the numbers ($X^2 = 34.26$, $df = 4$, $P > 0.001$). On the other hand, when the latter collection numbers (30 m into the field) are excluded, and the remaining four collections are subjected to chi square analysis, no significant difference in collection numbers is noted ($X^2 = 0.945$, $df = 3$, $P > .8$). The very obvious difference is the large number of beetles taken 30 m into the field. I believe this can be accepted as evidence that this species may have been clear of the ecotone at that point, since the field is its preferred habitat (Shubeck, 1983), and larger numbers of individuals would be expected to be there.

This study appears to indicate that there is a zone (ecotone), at least 15-30 m wide on either side of the field/woodland interface, within which there are no significant differences in the numbers collected (on either side of the interface) of *Oiceoptoma noveboracense*, *Oiceoptoma inaequale*, and *Necrophila americana*. *Nicrophorus orbicollis*, however, seemed to manifest an abrupt edge effect in that its numbers were taken in the woods and at the interface but not in the field. It appears for this species that the habitat preference for the woods is so strong that the concept of "ecotone" may be meaningless.

Table 1. Totals of carrion beetles collected (1984 & 1985) at 15 meter intervals along a base line which intersected a woodland and an adjacent field in Great Swamp National Wildlife Refuge, N.J.

SILPHIDAE	WOODS/ FIELD					TOTAL
	WOODS 30 m	WOODS 15 m	FIELD 0 m	FIELD 15 m	FIELD 30 m	
<i>Necrophila americana</i>	99	86	91	91	158	(525)
<i>Oiceoptoma noveboracense</i>	63	76	90	47	73	(349)
<i>Oiceoptoma inaequale</i>	58	21	61	24	42	(206)
<i>Nicrophorus orbicollis</i>	24	20	22	—	—	(66)
<i>Nicrophorus tomentosus</i>	—	2	5	1	4	(12)
<i>Nicrophorus pustulatus</i>	1	—	1	2	2	(6)
<i>Necrodes surinamensis</i>	—	1	4	—	—	(5)
<i>Nicrophorus marginatus</i>	—	2	—	—	2	(4)

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